United States Patent [19]

Loveless

[11] **3,762,664**

[45] **Oct. 2, 1973**

[54] **PNEUMATIC TUBE SYSTEM SWING TUBE DIVERTER CONSTRUCTION**

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[73] Assignee: **Diebold, Incorporated**, Canton, Ohio

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[52] **U.S. Cl.** **243/31**, 243/29

[51] **Int. Cl.** **B65g 51/24**

[58] **Field of Search** 243/29, 30, 31

[56] **References Cited**

UNITED STATES PATENTS

3,281,093	10/1966	Barber	243/29

FOREIGN PATENTS OR APPLICATIONS

1,155,854	6/1969	Great Britain	243/31
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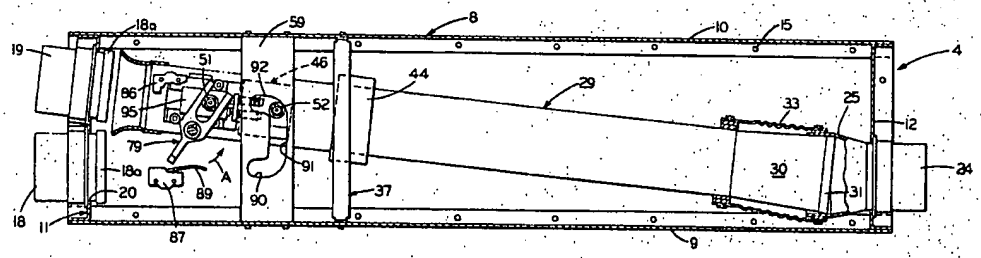
Primary Examiner—Evon C. Blunk
Assistant Examiner—Merle F. Maffei
Attorney—John H. Bishop et al.

[57] **ABSTRACT**

A swing tube diverter construction for multiple station pneumatic tube systems. A pneumatic tube section is mounted at one end to swing between two positions extending from a tube system main line. A pair of rollers is mounted on the swinging tube section adjacent the swinging end thereof. A rotatable drive yoke connected to a reversible motor has a slot engaged with one of the rollers. The other roller is engaged in a fixed generally U-shaped cam track. The cam roller follows the path of the cam track in cooperation with movement imparted to the swinging tube section by the other roller engaging the yoke. This selectively connects the swinging tube section to one or the other of two branch tube system legs. Thus a carrier may travel in either direction between the main line and a selected branch leg.

5 Claims, 12 Drawing Figures



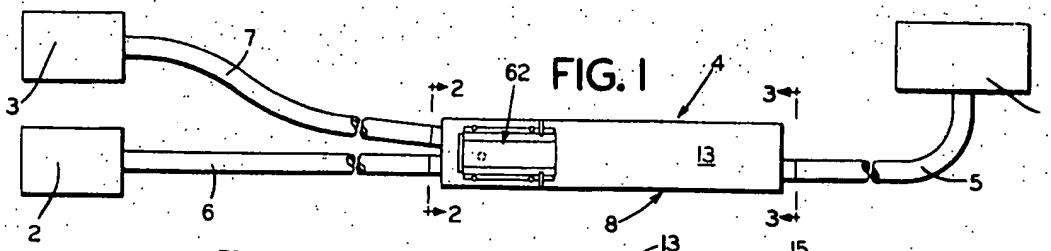


FIG. 1

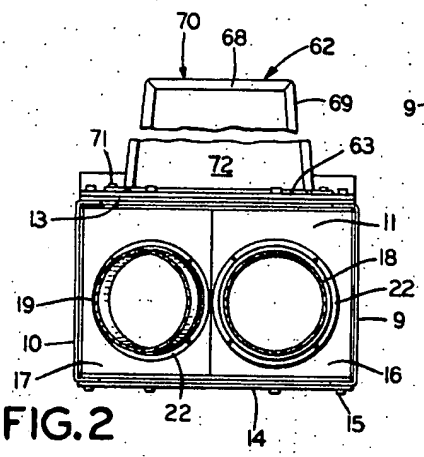


FIG. 2

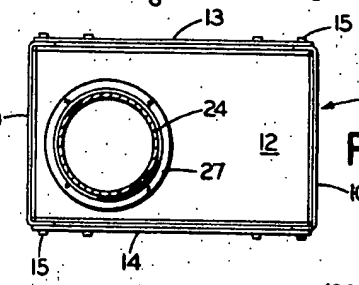


FIG. 3

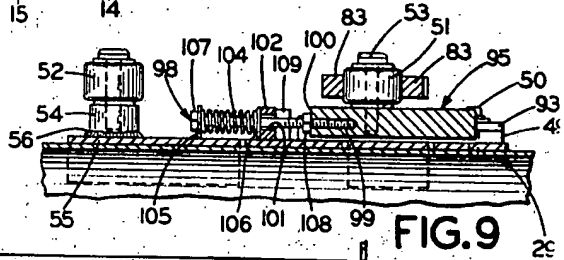


FIG. 9

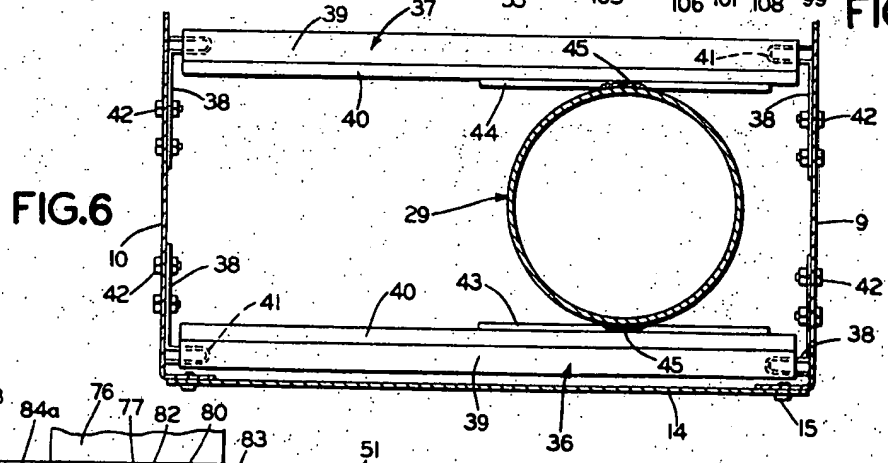


FIG. 6

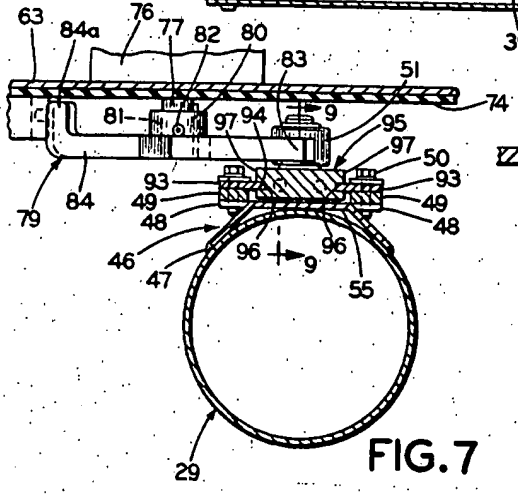


FIG. 7

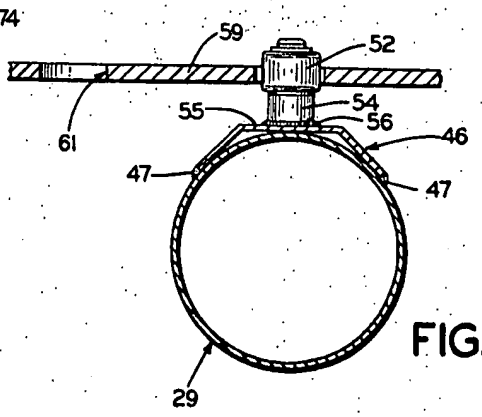


FIG. 8

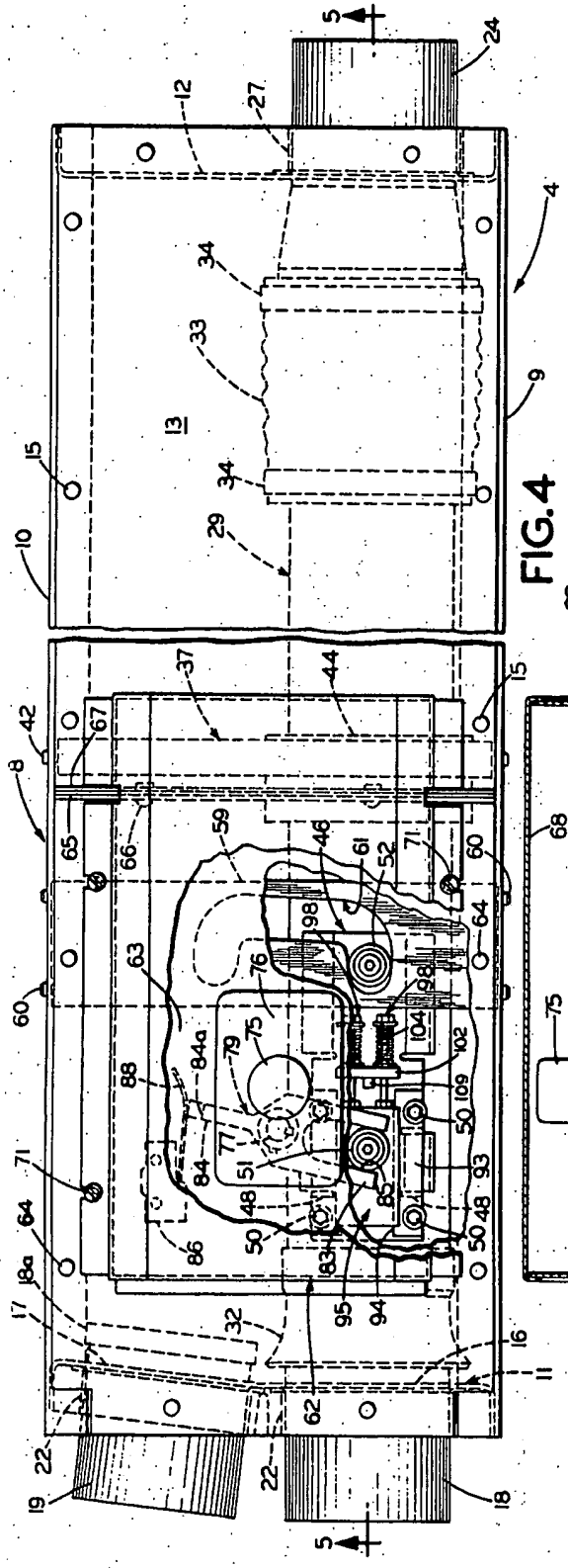


FIG. 4

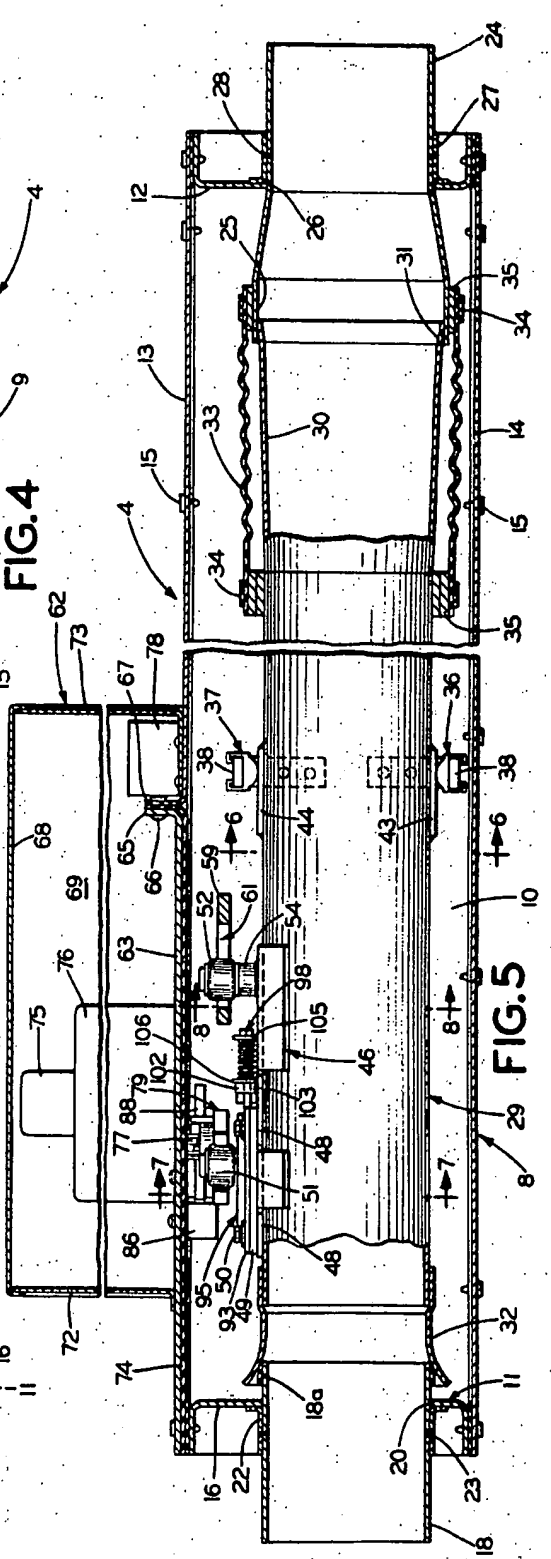


FIG. 5

FIG. 10

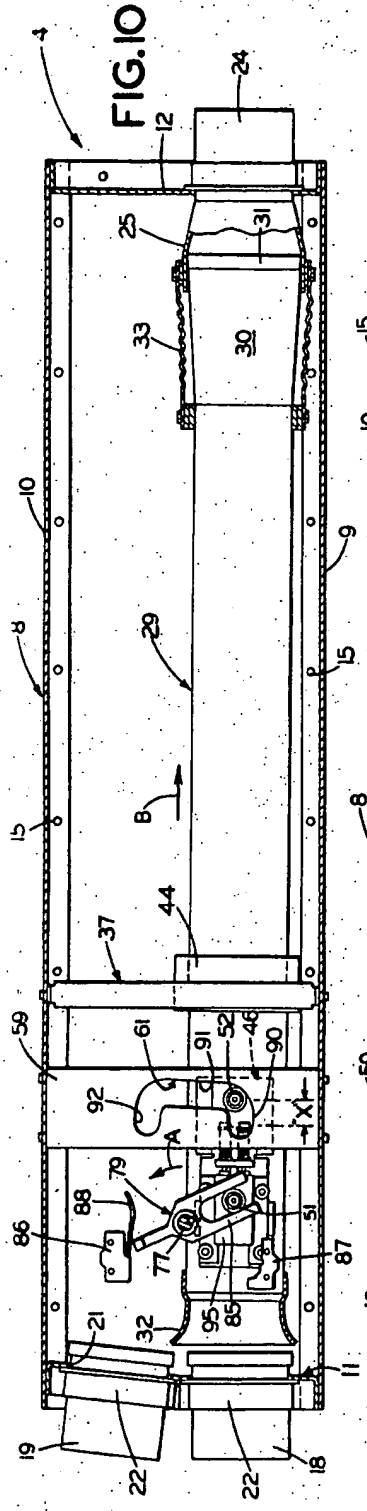


FIG. 11

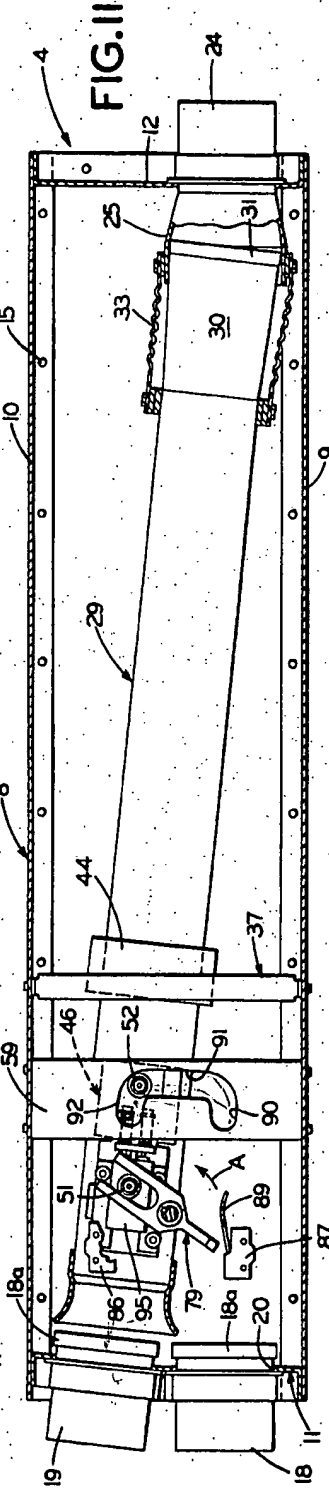
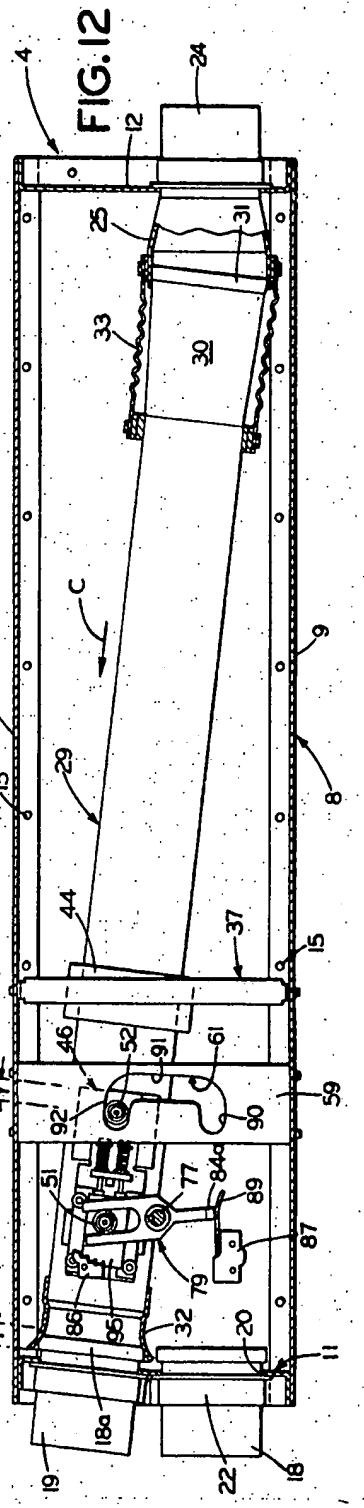


FIG. 12



PNEUMATIC TUBE SYSTEM SWING TUBE DIVERTER CONSTRUCTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to pneumatic tube systems and particularly to diverter constructions for such systems. More particularly the invention relates to a swing tube diverter construction which may be placed at various locations in a single tube, multiple station pneumatic tube system for diverting a moving carrier between either of two branch legs and a main line, regardless of the direction of carrier travel. The swing tube diverter may be controlled by limit switches and by a variety of electrical control mechanisms.

2. Description of the Prior Art

Various types of structures and mechanisms are used in pneumatic tube systems for diverting a moving carrier from a main line into branch lines at a junction station. Deflector structures are used at many terminal stations for deflecting the carrier into the proper terminal. Such deflectors consist of curved lever arms which project into the tube and deflect the carrier when the carrier strikes such member while the air pressure continues in the main line and is unaffected by the deflector.

Other carrier diverters used in pnuematic tube systems are similar to a deflector structure except that the diverter has the added feature of diverting the air flow as well as the carrier. The branch leg not traversed by the carrier moving through the tube junction is sealed off. The carrier therefore is propelled through the junction into the branch or main leg by the system air pressure without substantial impact with the diverting member in changing the direction of carrier travel.

Such a diverter construction is shown and described in the copending application of Pieter J. Ekama, Ser. No. 115,181, filed Feb. 16, 1971, now U.S. Pat. No. 3,701,496, dated Oct. 31, 1972.

Another type of carrier diverter used in pneumatic tube systems consists of a section of tube connected at one end with the main line and swingable between the branch lines for engagement therewith by the opposite swing tube end. Such a swing tube diverter construction is shown in U.S. Pat. No. 3,367,603.

The swing tube diverter construction disclosed in U.S. Pat. No. 3,367,603 provides a satisfactory device which solves many existing problems. Such diverter constructions, however, require spring means for the final movement of the swing tube into a sealed position and to ensure a seal in the final sealed position. Likewise, the moving force is applied to the swing tube through a lever-cam arrangement in which the cam has grooves for sliding engagement with the lever and swing tube. It is preferable to have the moving force applied more directly to the swing tube with reduced sliding engagement between the various components.

Likewise, prior swing tube diverters have involved difficulties in stopping the movement of the swing tube at the exact location desired, upon its connection with the selected branch tube. Override of the swing tube drive motor may improperly force the swing tube into or against the branch tube and may cause possible damage to the motor or misalignment of tubes and related components resulting in repair and maintenance problems. If adjustment is made for the motor override, a proper seal may not be achieved between the connected tubes should the amount of motor override vary. The use of motors having necessary built-in override protection and controls involves considerable extra expense.

Thus, a need exists for a swing tube diverter construction for use in a single tube pneumatic tube system which may be maintained easily, which permits a carrier to travel and be propelled in either direction through the diverter, which properly seats the swinging end of the tube sealed with respect to the selected branch tube without additional spring means, which provides a more direct coupling between the swing tube driving force and the swing tube, and which reduces the problem of motor override.

SUMMARY OF THE INVENTION

Objectives of the invention include providing a pneumatic system swing tube diverter construction which can be placed at various locations in a single tube pneumatic tube system; providing a swing tube diverter which permits a carrier to travel in both directions in the main leg and in both directions in the branch legs; providing a swing tube diverter which can be maintained or serviced easily; providing a swing tube diverter which can be controlled by limit switches and by various electrical control mechanisms; providing a swing tube diverter which has a stationary cam plate, and which has a direct coupling connected to the swing tube drive motor which is slidably engaged with the swing tube; providing a swing tube diverter which tightly seats the swing tube with respect to the branch leg ends without additional spring components; providing a swing tube diverter having motor override protection to prevent damage to the diverter construction, and to eliminate the need for extreme accuracy in the manufacture and assembly of the diverter and in the electrical control mechanism; and providing a swing tube diverter of simple construction which achieves the stated objects in a simple, effective and inexpensive manner, and which solves problems and satisfies needs existing in the art.

These and other objectives and advantages may be obtained by the swing tube diverter construction for a pneumatic tube system having main and branch tubes, the general nature of which may be stated as including swing tube means having first and second ends; means operative connecting the swing tube means first end to the system main tube providing limited axial and angular movement of said swing tube means with respect to said main tube, said connection means being substantially airtight; first and second pin means mounted on the swing tube means; drive means for moving the swing tube means between two positions each aligned with an end of one of two branch tubes, and for selectively engaging and disengaging the swing tube means second end with an end of a selected branch tube; said drive means including cam means formed with a generally U-shaped cam track engaged with the first pin means; yoke means having spaced leg means forming a slot therebetween engaged with the second pin means; reversible motor means operatively connected to the yoke means for rotating said yoke means; the pin means including roller means, the first pin means being journaled on spacer means mounted on the tube means; the second pin means being slidably mounted for limited axial movement along the swing tube means; spring means biasing the second pin means towards the

swing tube means first end; and switch means engaged by the yoke means controlling said drive means; said switch means deenergizing said drive means when the swing tube means engages a selected branch tube.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention — illustrative of the best mode in which Applicant has contemplated applying the principles — is set forth in the following description and shown in the drawings, and is particularly and distinctly pointed out and set forth in the appended claims.

FIG. 1 is a diagrammatic view of a pneumatic tube system in which one of the improved swing tube diverters may be used;

FIG. 2 is an enlarged sectional view of the swing tube diverter taken on the line 2—2, FIG. 1;

FIG. 3 is a similar view of the other end of the swing tube diverter taken on the line 3—3, FIG. 1;

FIG. 4 is a fragmentary top plan view of the swing tube diverter with portions broken away;

FIG. 5 is a fragmentary sectional view taken on line 5—5, FIG. 4;

FIG. 6 is an enlarged sectional view taken on line 6—6, FIG. 5;

FIG. 7 is an enlarged fragmentary sectional view taken on line 7—7, FIG. 5;

FIG. 8 is an enlarged fragmentary sectional view taken on line 8—8, FIG. 5;

FIG. 9 is a sectional view taken on line 9—9, FIG. 7; and

FIGS. 10, 11 and 12 are diagrammatic views showing the swing tube diverter in various positions of operation between the pneumatic tube branch legs.

Similar numerals refer to similar parts throughout the drawings.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A typical multiple station single-tube pneumatic tube system is illustrated diagrammatically in FIG. 1 and includes a central station 1 connected with substations 2 and 3 through the improved swing tube diverter 4. A single main pneumatic tube 5 is connected to station 1 and communicates at diverter 4 with branch tubes 6 and 7 which are connected to stations 2 and 3, respectively.

Diverter 4 (FIGS. 2–5) includes a housing 8 having side walls 9 and 10, end walls 11 and 12, and top and bottom walls 13 and 14. Top and botom walls 13 and 14 preferably are assembled to form housing 8 by screws 15 in order that such walls may be removed easily for maintenance of the diverter components assembled within housing 8. End wall 11 has two sections 16 and 17. Section 16 is generally parallel to end wall 12, and section 17 extends inwardly into housing 8 forming an angle with wall section 16.

Two short branch tube sections 18 and 19 are secured by flange collars 22 within openings 20 and 21 formed in end wall sections 16 and 17, respectively. Collars 22 are spot welded at 23 to end wall 11 and to tube sections 18 and 19 (FIGS. 2 and 5). A short main line tube section 24 formed with a bell end 25, is secured within an opening 26 formed in end wall 12 by a flange collar 27. Collar 27 is spot welded at 28 to end wall 12 and to tube section 24 (FIGS. 3 and 5).

Tube sections 18 and 19, and tube section 24 may be provided with flanges or the like at their outer ends for connection to branch tubes 6 and 7, and main line tube 5, respectively. A resilient collar 18*a* is mounted on the inner ends of tube sections 18 and 19 within housing 8 to provide quietness of operation and seals.

A length of tube indicated at 29 is mounted for swinging movement within housing 8. Tube 29 is formed at one end with an outwardly tapered end section 30 which terminates in a chamfered end 31. The other end of tube 29 terminates in a bell tube section 32. Chamfered end 31 is slidably mounted within bell end 25 of tube section 24 (FIG. 5) enabling tube 29 to move freely, both axially and angularly with respect to tube section 24.

A flexible sleeve 33 extends between tube 29 and tube section 24 and forms an airtight connection therebetween. Banding straps 34 secure sleeve 33 to tubes 29 and 24, and one or more layers of leather strips 35 or the like, preferably surround tubes 29 and 24 at straps 34. Strips 35 prevent straps 34 from wearing through sleeve 33. Sleeve 33 enables tube 29 to move freely with respect to tube section 24 and prevents tube 29 separating from tube section 24, while providing an airtight seal therebetween.

A pair of spaced guide bars 36 and 37 are mounted within housing 8 by clips 38 and extend between side walls 9 and 10 for supporting and guiding swing tube 29 (FIG. 6). Bars 36 and 37 each have a channel member 39 in which a guide strip 40 is inserted to provide a smooth surface for sliding engagement with tube 29. Guide strips 40 preferably are made of a low friction plastic or are coated with a low friction material, such as sold under the trademark "Teflon."

Clips 38 have generally U-shaped flange ends 41, one of which is inserted into each end of channel 39 for properly positioning bars 36 and 37 above and below tube 29. Clips 38 preferably are bolted to side walls 9 and 10 by bolts 42.

A pair of slide plates 43 and 44 preferably are welded at 45 to tube 29 and are located to coincide with guide bars 36 and 37 (FIGS. 5 and 6), respectively. Plates 43 and 44 provide elongated smooth surfaces which slidably engage guide strips 40 during movement of tube 29, so that a depression will not be worn in tube 29 by strips 40 after repeated operations of diverter 4.

A channel-like bracket 46 is welded at 47 on tube 29 between slide plate 44 and bell tube end 32 (FIGS. 5, 7 and 8). A roller 52 is journaled on the upper end of a spacer hub 54 which extends upwardly from web 55 of bracket 46. Hub 54 is welded at 56 to bracket web 55. Roller 52, thus comprises pin means mounted or journaled on tube 29.

Pairs of ears 48 (FIG. 7) extend horizontally outwardly from both sides of bracket web 55. Spacer bars 49 extend parallel to the axis of tube 29 between each pair of ears 48 and are bolted thereto by bolts 50.

Guide bars 93 are mounted on spacer bars 49 by bolts 50. Each guide bar 93 has an inner side edge 94 which is spaced from and extends over web 55. A slide block 95 is formed with grooves 96 which extend along opposite sides 97 of block 95. Slide block 95 is slidably mounted on guide bars 93 by engagement of guide bar edges 94 in grooves 96. Guide bars 93 preferably mount slide block 95 above bracket web 55, as shown in FIG. 7, to prevent sliding friction therebetween.

A roller 51 is journaled on the upper end of a pin 53 which is fixed to and extends upwardly from slide block 95.

A pair of parallel bolts 98 are engaged in threaded bores 99 formed in an end 100 of block 95, which end 100 is adjacent roller 52. Bolts 98 extend through holes 101 formed in a retaining bar 102 which is welded at 103 to bracket web 55. Retaining bar 102 is located between roller 52 and slide block 95.

Compression springs 104 surround bolts 98 and are retained on bolts 98 by spaced washers 105 and 106 which abut boltheads 107 and retainer bar 102, respectively. Nuts 108 are threaded on each bolt 98 and are secured against end 100 of block 95 to lock bolts 98 in position with respect to block 95. Nuts 108 also may serve as stops for block 95 which is biased toward retaining bar 102 by springs 104.

A pad 109 of leather or resilient material preferably is mounted on retainer bar 102 between bolts 98 and extends outwardly beyond nuts 108 to absorb any stopping shock between block 95 and bar 102. Pad 109 also provides quiet operation of diverter 4.

Bores 99 extend further into slide block 95 than the ends of bolts 98, as shown in FIG. 9, to permit bolts 98 to be adjusted with respect to block 95 to vary the compression tension of springs 104.

Roller 51 thus is mounted movably axially with respect to tube 29 for movement away from and toward roller 52 by the sliding connection between slide block 95 and guide bars 93. Springs 104 bias block 95 and roller 51 toward roller 52. The function and purpose of slide block 95 and attached roller 51 are discussed below.

A cam plate 59 is mounted within housing 8 extending between side walls 9 and 10, and is attached to walls 9 and 10 by bolts 60. Cam 59 is spaced above tube 29 and is formed with a generally U-shaped cam track slot 61 into which roller 52 extends.

A second housing 62 is mounted on the outside of housing 8 and houses the drive means for swing tube 29. Housing 62 includes a motor mounting plate 63 which along with top wall portion 13 forms the complete top wall for housing 8. Plate 63 is connected by screws 64 to side walls 9 and 10 and to front end wall 11. The rear end of plate 63 is flanged at 65 and is bolted at 66 to top wall flange 67 (FIG. 5).

The top and side walls 68 and 69, respectively, of housing 62 are formed by a hood-like cover 70 which is connected by screws 71 to motor plate 63 (FIG. 7). Front and rear end wall panels 72 and 73 are welded to hood cover 70 to form housing 62. A gasket 74 of neoprene or the like may be cemented to the bottom surface of motor plate 63.

The drive means for swing tube 29 preferably includes a motor 75 and a gear box 76 mounted on motor plate 63. A shaft 77 is connected to and extends from gear box 76 through an opening in plate 63 and gasket 74 into housing 8. An electrical wiring terminal block 78 or other electrical control components may also be mounted within housing 62 (FIG. 5).

A yoke 79 is mounted on the extended end of shaft 77 within housing 8 and engages roller 51 (FIG. 7). Yoke 79 includes a hub 80 formed with an opening 81 in which shaft 77 is engaged and secured therein by set screws 82. A pair of spaced parallel legs 83 extend outwardly from hub 80 forming a slot 85 between legs 83. Slot 85 has a width generally equal to the diameter of roller 51 and traps roller 51 therein.

A third yoke leg 84 extends outwardly from hub 80 in a direction opposite to that of legs 83. An upturned tip 84*a* is formed on the extended end of leg 84 for operating diverter control switches.

A pair of such control micro switches 86 and 87 preferably are mounted on motor plate 63 within housing 8 for controlling diverter drive motor 75. Actuating levers 88 and 89 extend outwardly from switches 86 and 87, respectively, which are engaged by yoke tip 84*a* when swing tube 29 reaches a predetermined position to stop motor 75.

The operation of diverter 4 is shown diagrammatically in FIGS. 10, 11 and 12, to switch swing tube 29 between branch tube section 18 and 19 for movement of a carrier through main tube 5 and branch tubes 6 and 7. Swing tube 29 is shown in FIG. 4 in engaged position with branch tube section 18 for movement of a carrier in either direction in main line 5 and branch line 6. Slide block 95 is moved towards the branch tube section, compressing springs 104, when swing tube 29 is in the engaged position of FIG. 4.

Switching of diverter 4 for carrier movement between station 1 and stations 2 and 3 is achieved through various usual control circuits which energize motor 75. When energized, motor 75 rotates shaft 77 at the desired speed through gear box 76. Shaft 77 rotates yoke 79 in the direction of arrow A, FIG. 10, and as yoke 79 moves, roller 51 engaged in slot 85 moves slide block 95 rearwardly towards retainer bar 102, expanding springs 104, until block 95 abuts stop pad 109. Tube 29 then is moved axially rearwardly in the direction of arrow B from the engaged or seated position shown in FIG. 4 to the retracted position shown in FIG. 10, due to the continued force exerted by yoke 79 on roller 51 which now is held fixed with respect to tube 29.

Tube 29 moves axially rearwardly a distance "X" (FIG. 10) due to roller 52 following axially aligned leg 90 of cam track slot 61. Thus, bell tube section 32 of tube 29 is disengaged from tube section 18 only that distance necessary for bell tube 32 to swing clear of tube section 18. Chamfered end 31 of tube 29 slides easily within bell end 25 of tube section 24 the distance "X" while flexible sleeve 33 continues to connect tubes 29 and 24.

As shaft 77 continues to rotate in the counterclockwise direction of arrow A (FIG. 11), bell tube 32 and tube 29 swing generally angularly within housing 8 to the position shown in FIG. 11, where tube 29 is axially aligned with tube section 19. The path of movement of tube 29 is controlled by roller 52 following the generally laterally extending center section 91 of cam track slot 61. Tube end 31 shifts accordingly in bell end 25 of tube section 24 to compensate for the swinging movement of tube 29, enabling tube 29 to remain connected with the tube section 24.

Roller 51 remains in biased position within yoke slot 85 as tube 29 swings laterally away from tube 18 until tube 29 is axially aligned with tube 19 (FIG. 11).

Tube 29 then moves axially forwardly (arrow C, FIG. 12) along cam track leg 92 a distance "Y" towards and with respect to tube section 19 as shaft 77 continues to rotate yoke 79, slightly compressing springs 104, until bell tube 32 is firmly seated against tube section 19 (FIG. 12). Leg tip 84*a* of yoke 79 contacts switch actuating lever 89 when bell tube 32 reaches its seated posi-

tion with the tube section 19, deenergizing motor 75 and stopping rotation of shaft 77. Motor 75 remains deenergized until the diverter controls receive the proper signal for actuating motor 75 in the other direction and for moving swing tube 29 back to sealed engagement with tube section 18.

The operation of the mechanism to move tube 29 from the position of FIG. 12 back to the position of FIG. 4 is similar to that described for movement of tube 29 from the position of FIG. 4 to that of FIG. 12. Motor 75 rotates shaft 77 and yoke 79 in the reverse or clockwise direction moving roller 52 along cam track slot 61. Tube 29 first moves axially away from tube 19, disengaging bell tube 32 from tube 19, then tube 29 swings from the position of FIG. 11 to that of FIG. 10, and then tube 29 moves axially toward and engages bell tube 32 with tube section 18 (FIG. 4). Yoke 79 actuates switch lever 88 when bell tube 32 seats against tube section 18, deenergizing motor 75.

Branch tube section 18 and cam track leg 90 are aligned axially with respect to one another as shown in FIGS. 4 and 10 when tube 29 is seated against tube 18. Tube section 19, likewise is axially aligned with cam track leg 92, as shown in FIGS. 11 and 12 when tube 29 is seated against tube 19. This relation is obtained by the inclined position of end wall portion 17 and the formation of cam track leg 92 at an angle with respect to cam track leg 90.

The strips 40 in guide bars 36 and 37 preferably maintain sliding contact with slide plates 43 and 44 at the various positions of tube 29, during movement of tube 29 between branch tube sections 18 and 19, as is shown in FIGS. 5, 10, 11 and 12. Lower bar 36 supports the weight of tube 29 and in cooperation with upper bar 37 properly positions tube 29 with respect to tubes 18 and 19. Bar 37 prevents tube 29 from moving away from lower bar 36 from forces exerted on tube 29 by the propelling air currents or by a carrier moving through tube 29.

An important concept and aspect of the invention is the spring-biased, movable mounting of roller 51 in order to provide motor override protection. Diverter 4 would operate satisfactorily should roller 51 be mounted stationary with respect to tube 29 as is roller 52 since it is the force exerted on roller 51 by the legs 83 of yoke 79 which moves bell tube 32 into sealing engagement with the branch tube sections and not the resilience of springs 104 or the sliding movement of block 95.

However, it is difficult and expensive to provide a control system for and to maintain exact alignment between, the various components of the diverter so that the movement of the tube 29 is stopped at the exact instant that the tube 29 seats with a selected branch tube. The motor can coast or override after being deenergized. This may jamb tube 29 against the selected branch tube and may result in damage to or misalignment of the tubes or damage to the motor, control or operating mechanisms.

The construction of the spring-biased, movably mounted slide block 95 and attached roller 51, and the particular formation of cam plate track slot 61 minimizes such override and alignment problems. When tube 29 is in carrier transfer position with bell tube 32 properly engaged with a branch tube (FIGS. 4 and 12), roller 52 is not located at the end of one of the cam legs 90 and 92. Thus, bell tube 32 may move axially through the clearance space to properly seat and seal against the branch tube, before the roller 52 engages an end of one of the leg openings 90 and 92.

If motor override does occur, springs 104 are compressed by the continual forward movement of slide block 95 and roller 51, and absorb the override force instead of this force being exerted directly against and absorbed by the connected branch tube. Roller 52 can continue to travel a short override distance in cam track slot 61 before contacting cam plate 59. Spring 104, however, will absorb any override before roller 52 reaches the end of cam track 61 preventing undesirable forces from acting on the diverter components.

Tube 29 including bell tube 32, and branch tube sections 18 and 19 preferably are made of metal such as aluminum. This metal-to-metal contact between bell tube 32 and a branch tube provides a sufficiently airtight seal for satisfactory diverter operation. Such contact however, does create undesirable noise which is eliminated easily by mounting resilient collars 18a on the inner ends of branch tube sections 18 and 19.

Diverter 4 may be placed at any desired location in a pneumatic tube system and will accept carrier movement in either direction through any of its legs or branches, since there are no guide members controlled by or dependent upon movement of the carrier.

Likewise, the velocity of the carrier after passage through diverter 4 is not affected, since the same air flow, pressure or vacuum, acts upon the carrier before and after movement through diverter 4. Any number of diverters may be used in a single pneumatic tube system since only those tube sections through which a carrier is directed to travel between selected stations are connected and open for carrier movement air flow. Thus, the air pressure or vacuum required for system operation is not substantially affected by the number of branch legs and stations present in a multiple station system.

Accordingly, the improved diverter construction provides for diverted carrier movement to or from either of two branch legs and a main leg at a Y-junction section regardless of the direction of carrier travel in a quiet and effective manner; enables a single tube pneumatic tube system to have numerous branch lines and terminal stations without substantially affecting the air flow requirements for operation of the system; enables a carrier to be diverted between a branch leg and a main leg at a Y-junction section smoothly and easily propelled by air flow in a pneumatic system; enables the diverter to be placed at various locations within a pneumatic tube system; reduces the problems caused by the override of the swing tube drive motor and provides for a more direct coupling with the drive motor; provides for positive seating of the swing tube with the branch tubes by force applied directly from the drive motor; provides such a construction which is effective, safe, inexpensive, and efficient in assembly, operation and use, and which achieves all the enumerated objectives, and provides for eliminating difficulties encountered with prior devices, and solves problems and obtains new results in the art.

In the foregoing description, certain terms have been used for brevity, clearness and understanding; but no unnecessary limitations are to be implied therefrom beyond the requirements of the prior art, because such terms are used for descriptive purposes and are intended to be broadly construed.

Moreover, the description and illustration of the invention is by way of example, and the scope of the invention is not limited to the exact details of the construction shown or described.

Having now described the features, discoveries and principles of the invention, the manner in which the improved swing tube diverter is constructed, assembled and operated, the characteristics of the new construction, and the advantageous, new and useful results obtained; the new and useful structures, devices, elements, arrangements, parts and combinations are set forth in the appended claims.

I claim:

1. Swing tube diverter construction for a pneumatic tube system having a main tube and a pair of branch tubes including, swing tube means having first and second ends; means operatively connecting the swing tube means first end to the system main tube providing limited axial and angular movement of said swing tube means with respect to said main tube, said connection means being substantially airtight; first and second pin means mounted on the swing tube means; means resiliently mounting the second pin means on the swing tube means for limited axial movement therealong; drive means for moving the swing tube means between two positions each aligned with an end of one of the two branch tubes, and for selectively engaging and disengaging the swing tube means second end with an end of a selected branch tube; said drive means including a stationary cam plate spaced from and extending transversely across the swing tube means and formed with a U-shaped cam track; said cam track having a pair of spaced leg portions, each leg portion extending axially towards and aligned with one of the branch tubes; the first pin means being engaged with the cam track and movable therealong as the swing tube means moves between the branch tubes; yoke means spaced from the swing tube means and having spaced leg means forming a slot therebetween engaged with the second pin means; reversible motor means for rotating said yoke means; the motor means having a shaft; and the yoke means being mounted on said motor means shaft.

2. Swing tube diverter construction for a pneumatic tube system having main and branch tubes including, swing tube means having first and second ends; means operatively connecting the swing tube means first end to the system main tube providing limited axial and angular movement of said swing tube means with respect to said main tube, said connection means being substantially airtight; first and second pin means mounted on the swing tube means; means movably mounting the second pin means on the swing tube means for limited axial movement of said second pin means along said swing tube means; spring means engaging the second pin means biasing said second pin means towards the swing tube means first end; drive means for moving the swing tube means between two positions each aligned with an end of one of two branch tubes, and for selectively engaging and disengaging the swing tube means second end with an end of a selected branch tube; said drive means including cam means formed with a generally U-shaped cam track engaged with the first pin means; yoke means having spaced leg means forming a slot therebetween engaged with the second pin means; and reversible motor means operatively connected to the yoke means for rotating said yoke means.

3. Diverter construction as defined in claim 2 in which the second pin means mounting means includes guide means mounted on the swing tube means; in which block means is slidably mounted on said guide means; and in which the second pin means is mounted on the block means.

4. Diverter construction as defined in claim 3 in which the spring means includes retainer means mounted on the swing tube means; in which bolt means having first and second ends are movably mounted on the retainer means; in which said bolt means first end is connected to said slide block means; in which the spring means also include a compression spring which surrounds a portion of said bolt means; and in which said compression spring is retained between the retainer means and the bolt means second end.

5. Swing tube diverter construction for a pneumatic tube system having main and branch tubes including, swing tube means having first and second ends; means operatively connecting the swing tube means first end to the system main tube providing limited axial and angular movement of said swing tube means with respect to said main tube, said connection means being substantially airtight; first and second pin means mounted on the swing tube means, said pin means each including a roller; a bracket mounted on the swing tube means; block means movably mounted on said bracket; the first pin means roller being journaled on the bracket and the second pin means roller being journaled on the block means; drive means for moving the swing tube means between two positions each aligned with an end of one of two branch tubes, and for selectively engaging and disengaging the swing tube means second end with an end of a selected branch tube; said drive means including cam means formed with a generally U-shaped cam track engaged with the first pin means; yoke means having spaced leg means forming a slot therebetween engaged with the second pin means; and reversible motor means operatively connected to the yoke means for rotating said yoke means.

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Feb. 6, 1968 A. FEYERHERD 3,367,603

PNEUMATIC DISPATCH SYSTEM

Filed July 11, 1966 5 Sheets-Sheet 1

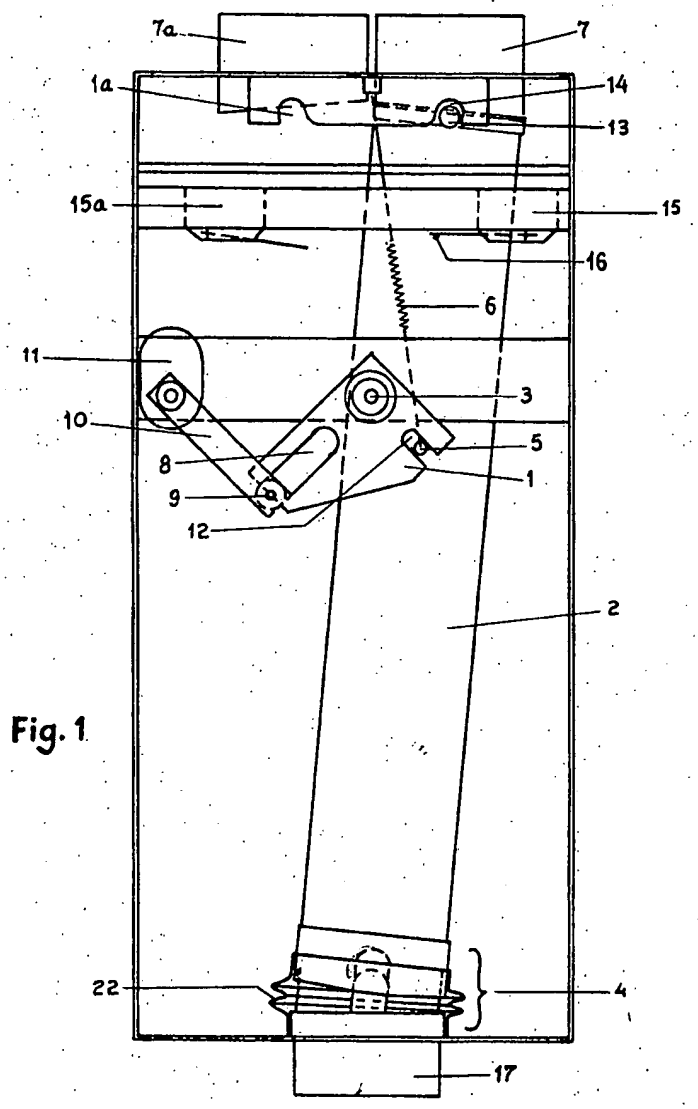


Fig. 1

Feb. 6, 1968 A. FEYERHERD 3,367,603

PNEUMATIC DISPATCH SYSTEM

Filed July 11, 1966 5 Sheets-Sheet 2

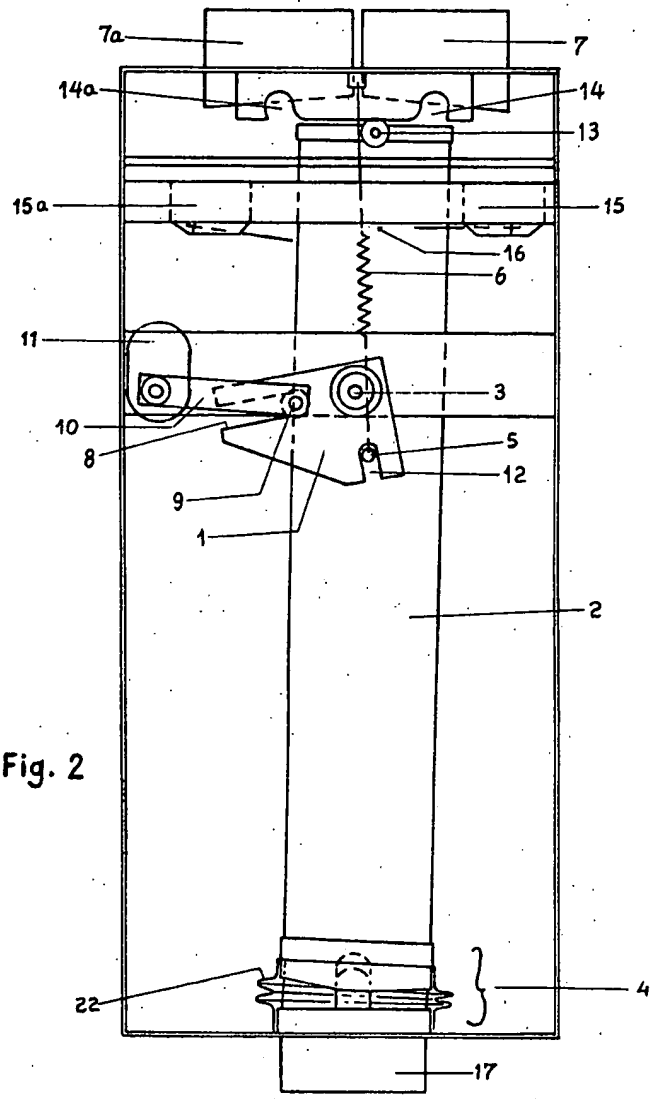


Fig. 2

F b. 6, 1968 A. FEYERHERD 3,367,603

PNEUMATIC DISPATCH SYSTEM

Filed July 11, 1966 5 Sheets-Sheet 3

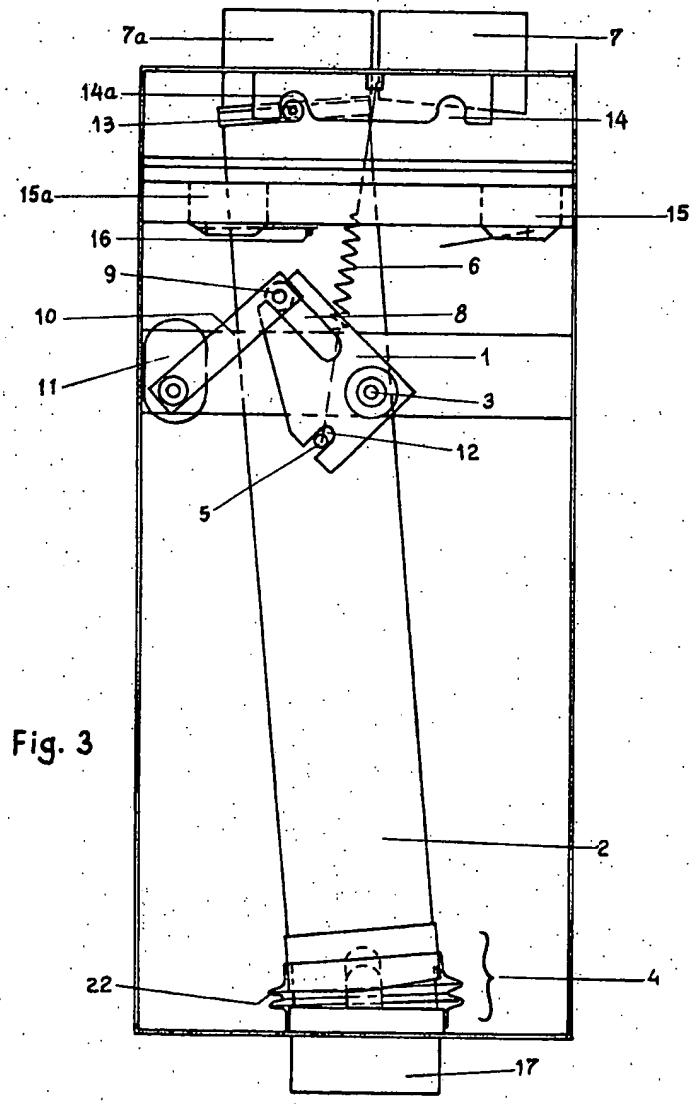


Fig. 3

Feb. 6, 1968 A. FEYERHERD 3,367,603

PNEUMATIC DISPATCH SYSTEM

Filed July 11, 1966 5 Sheets-Sheet 4

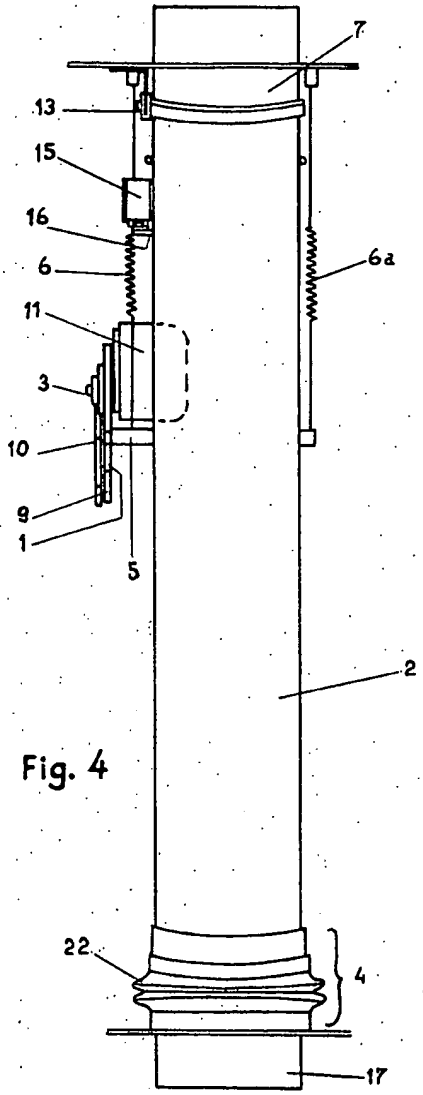


Fig. 4

Feb. 6, 1968 A. FEYERHERD 3,367,603

PNEUMATIC DISPATCH SYSTEM

Filed July 11, 1966 5 Sheets-Sheet 5

Fig. 5

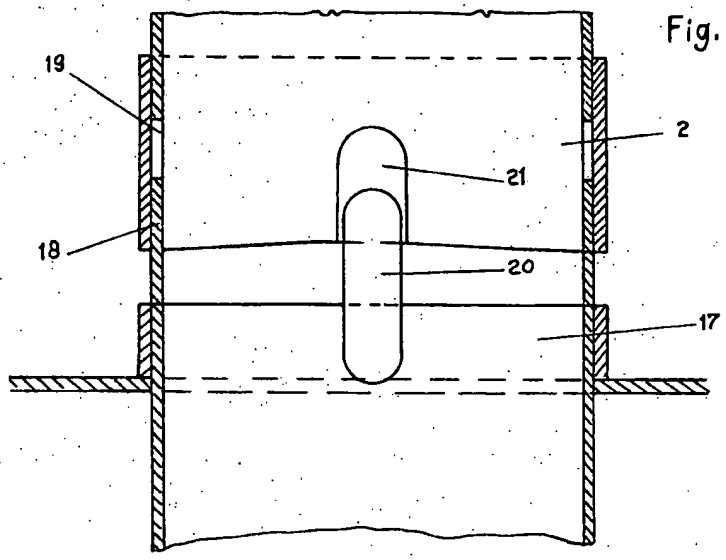
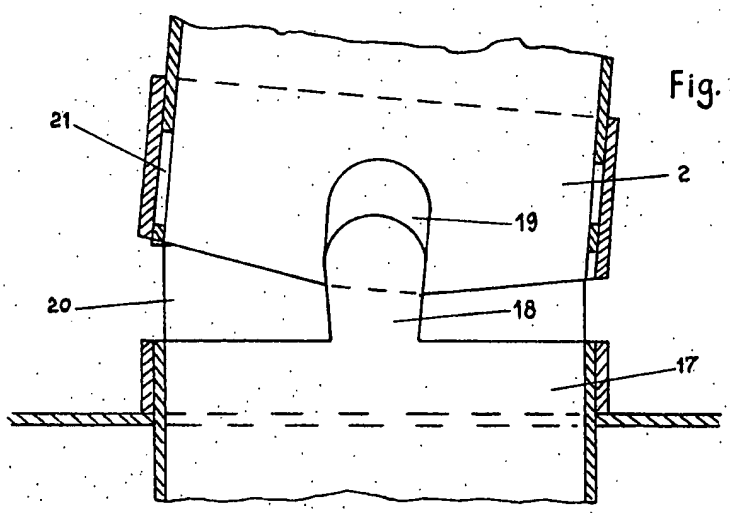


Fig. 5a



United States Patent Office 3,367,603
Patented Feb. 6, 1968

3,367,603

PNEUMATIC DISPATCH SYSTEM

Alexander Feyerherd, Bad Honnef, Germany, assignor to Rotterdamse Telecommunicatiemaatschappij N.V., Rotterdam, Netherlands

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Claims priority, application Germany, July 10, 1965, F 46,575
6 Claims. (Cl. 243—29)

ABSTRACT OF THE DISCLOSURE

A pneumatic dispatch system in which the ends of two pneumatic tubes are adapted for being selectively coupled to a trunk pipe line by a switch tube pivotably connected at one end to the trunk pipe line with axial freedom and elastically urged against said line, the switch tube being subjected to the action of a pivotal carrier driven through a limited angle for moving the switch tube between the pneumatic tubes, the carrier having a slot receiving a pin on the switch tube to displace the pin and thereby the switch tube axially away from the pneumatic tubes when the switch tube is moved from one pneumatic tube to the other.

My invention relates to pneumatic dispatch systems with air tight switches and in particular to such systems in which the switch consists of a swingable tube which on the one hand is connected via a joint to a guide tube track and on the other hand has an end with a seal which can be arbitrarily aligned with the ends of two guide tubes. Such switches are known. The problem of their actuation, however, has not yet been satisfactorily solved. A magnetic actuation, which at present is customary, has many disadvantages. This is the case since it is necessary to swing the free end of the switch tube for at least its full diameter, and on account of the fact that over this distance the strength of the magnetic field decreases considerably, it is necessary to employ very great magnetic strengths even with small tube diameters, while switch tubes with larger diameters cannot be economically operated in this way.

Another disadvantage is that the swing forces continuously decrease on approaching the final position, so that great shock loads are produced which are not only applied to the switch tube but also to the complete installation which give rise to disturbing noise.

Apart from the fact that great forces are required owing to the sealing faces scraping over one another there is also a great wear and tear and consequently much upkeep and a reduced reliability of service.

It has already been suggested to use additional magnets in order to achieve a minor axial movement of the switch tube. Due thereto the wear and tear of the sealing faces can be reduced but a considerably greater energy is required since the attractive forces of the magnets counteract the effect of the turning magnets. In this embodiment the poles of at least a part of the magnets should be reversed whereby the quantity of energy required for magnetization is considerably increased, since with each reversal of the poles for the creation of the desired magnetic field the existing permanent magnetic field must first be destroyed.

Mechanical drives have not been put into use as they are mostly complicated and their construction lacks efficiency.

It is an object of the invention to provide a very simple and efficient air tight switch tube with a mechanical drive. According to the invention a carrier member for a single switch tube is employed for that purpose, the said carrier member being capable of rotation about a fixed axle

through an arc having a radius substantially smaller than the swing radius of the switch tube, the carrier member being connected to the switch tube to urge the switch tube in an axial direction away from the joint formed with the guide tubes against the action of a spring urging the switch tube in the direction of the exit tube.

In this way the desired course of movement is obtained at the joint of the switch tube and the guide tubes, namely first an axial movement in a direction away from the guide tubes, thereafter a turning movement at increased speed which at the end is automatically slowed down, and finally an almost purely axial movement for pressing the switch tube packing against the exit tube.

This can be clarified briefly as follows: each semicircular movement proceeds at its end in a reversed direction as compared with that at the beginning, a transverse movement being made in the central part. If this movement is combined with a movement ranging a curve in opposition thereto this results in a movement curve which resembles a compound curve and consequently is an approximation of the desired curve of movement.

In fact no curvature guides and reversals of movement are required. According to the basic principle of the invention the swing drive for the switch tube can in a simple way be constructed in such manner that a swinging lever driven by a motor is directly coupled to the switch tube.

For practical reasons it is, however, advisable to interpose a free travel between the switch member and its driving member. Even if it is assumed that the driving motor can be switched off with great exactness it cannot be denied that the factors determining the extent of afterrun of the motor, like the consistency of the lubricant or other frictional resistances, often change.

On the other hand in practice often an angular movement much smaller than 180° suffices, since the exactness of the axial movement of the swinging tube is immaterial and too great axial movements in the joint would complicate the construction thereof.

Consequently in a preferred embodiment two slots are provided in the switch member which are at an angle—preferably at right angles, with each other, a swinging lever, driven by a motor and provided with a carrier cam e.g. a roller, being capable of engaging one slot, and a cam secured to the switch tube and serving as a point of application engaging the other slot, it being advisable for reasons which will be disclosed hereinafter that the slot of the switch member and, if need be, the slot for the carrier pin, too, are open at one end.

At any rate it is advisable that a guide, or locking roller, is disposed on the switch tube and a guide or locking slot is provided on each of the exits. It is further possible to provide end switches which can be actuated by an operating pin on the switch tube and which permit switching the motor off and/or short-circuiting its armature winding.

An especially efficient joint structure, which in connection with the basic idea of the invention is very advantageous and which enables the switch tube to follow the course of movement determined by the special character of the drive and which allows to eliminate all frequently occurring disturbances, is finally realized in the way that for the formation of the axially yielding joint two oppositely situated lips are provided on the fixed tube part which in conformity with the circumference of the tube may be curved, the switch tube having corresponding recesses of a shape and depth such that the switch tube in respect of the fixed tube part can both perform a limited axial movement and a swinging movement, while further at diametrical locations on this fixed tube part and staggered through 45°, 60° or 90° in respect of the lips there are provided lip shaped plate springs, while at

the corresponding locations of the swinging tube matching recesses are provided according as two, four or six resilient lips besides the guide lips are applied at different tube diameters.

The invention is described in further detail with reference to the accompanying drawing. In the drawing:

FIGURES 1–3 are diagrammatic side elevation views of the devices according to the invention in which various stages of movement are shown.

FIGURE 4 is a side elevation view of the device in FIGS. 1–3 turned through 90°.

FIGURES 5 and 5*a* show on enlarged scale details of the device.

According to FIGS. 1 to 4, an oblong swinging tube **2** is pivotably connected via a joint **4** with a fixed carrier tube **17** in order to communicate selectively with exit tubes **7**, **7***a*, with an air tight connection. For that purpose a switch or carrier member **1** is provided which is swingable about an axle **3** in the frame, the said member producing movement of a carrier pin **5** secured to the swinging tube **2**. Springs **6** and **6***a* serve to ensure an air tight connection between tube **2** and one of the exit tubes **7** or **7***a* in the final positions of the switch tube **2**. The sealing faces proper are not specially denoted. In order to transmit the motion from the motor **11** to the switch member **1**, a lever **10** is provided which with its carrier roller **9** can engage a notch **8** of the switch member **1** and consequently, when the lever **10** is swung, move the switch piece from the one final position into the other final position, as is illustrated in FIGS. 1 and 3.

A second slot **12** is provided in order to receive the pin **5** and to transport pin **5** therein to constitute a coupling which connects the switch member **1** with the swinging tube **2** and yields to an extent.

At the end of the swinging tube **2** in the vicinity of the exit tubes is a guide roller **13** which in the final positions can either engage a corresponding guide notch **14** on the exit tube **7** or a corresponding notch **14***a* on the exit tube **7***a*. Furthermore micro switches **15** and **15***a* are provided as end switches, which are activated by a pin **16** on the swinging tube **2** at the end of the path of movement and which deenergize or brake the motor **11**.

The operation is as follows. In order to swing the switch tube **2**, the motor **11** is excited by means of a selector device in the emitter station. On the output shaft of motor **11** the swing lever **10** is fixedly mounted. The roller **9** enters the notch **8** of the switch piece **1** and moves the latter from the position in FIG. 1 into that according to FIG. 3 or vice versa. In this way an approximately U-shaped curve of movement of the carrier pin **5** is produced. In the last part of the movement, which is substantially axial in which the roller **13** enters one of the guide grooves **14**, **14***a*, respectively, the pin **16** contacts the switch strip of one of the micro switches **15** or **15***a* and switches the motor off and short circuits, if need be, the armature winding thereof in order to keep the afterrun of the motor within narrow bounds.

For that purpose the motor may conveniently be constructed as a direct current motor with a permanent magnetic field excitation since in such a motor the direction of rotation can be changed by reversing the polarity and furthermore it can be short circuited so as to be braked.

If now the slot **8**, as represented, is open at one end the roller **9**, can leave the slot in the event there is a certain afterrun of the motor. The switch members remains in its defined position since the swinging tube **2** is locked at the exit and retained at that position by the carrier pin **5**. When the driving motor **11** is again switched on, the roller **9** enters the notch **8** without difficulty and swings the switch member, and in the new position the roller **9** can leave the notch **8** without difficulty, although this is not necessary. This kind of free travel has appeared to be very efficient, since no braking or abutment forces are transmitted to the frame on account of its function. Even when the swinging tube contacts the exit under the

action of the springs **6** and **6***a* this is not effected all at once but in a way controlled by the movement of the switch member **1**. As a result the desired kind of movement is more or less automatically obtained, namely, at first the swinging tube is lifted slowly from the exit tube, while subsequently the swing is gradually accelerated and then decelerated, after which the tube is placed on the other exit tube. In addition thereto, the noise of the switch over is extraordinarily small. Shocks in the driving gear are entirely avoided. The motor can start without load and after being switched off it can run out freely. The required controlling power remains small and the charging rate is almost constant in operation. A controlling power is only required during the switch operation which in practice lasts only about 400 microseconds.

The bias of the springs **6** and **6***a* need not be changed since it is not essential. It should only support to an extent the automatic movement of the swinging tube into the sealing position and ensure the tightness in the final position.

Another advantage is in that the swinging tube **2** cannot be moved out of its position by a container passing at a high speed. In order to eliminate obstacles in the joint and to be able to utilize fully the reliability of the switch at the high speeds at which the containers travel through the system, this joint is constructed in a special way as shown in FIGS. 5 and 5*a*. At the tube end **17** are provided guide lips **18** and in the switch tube **2** corresponding recesses **19** are provided of such shape and depth that the swinging tube according to FIG. 5 can perform a swinging movement perpendicular to the plane of the drawing and as seen in FIG. 5*a*, in the drawing plane and parallel thereto, respectively, while also being capable of undergoing longitudinal movement relative to tube end **17**. The lips **18** are curved in conformity with the circumference of the tube end **17**, and the swinging tube **2**, respectively. Staggered at right angles therewith are resilient lips **20** on the tube end **17**, the said lips engaging recesses **21** in the swinging tube. In this case attention has also been given to the fact that the axial movement should not be hampered and that moreover the swinging movement can be effected without changing the inner diameter. In this way a shock free guiding of the container in the pneumatic system is obtained which not only allows higher speeds but moreover achieves this at a reduced effort of the blower.

A special advantage of the switch according to the invention is that not only can pneumatic tube systems with nominal widths of 60 mm. be operated at a minimum consumption of energy, but also such systems having nominal widths of 90 mm., 110 mm. and so on without an essential increase of the controlling power.

Having thus described the invention and manner of its operation what I claim as my invention is:

What I claim is:

1. In a pneumatic dispatch system in which the ends of two pneumatic tubes are to be selectively coupled to a trunk pipe line, an improvement comprising a switch tube having opposite ends, means connecting the switch tube at one of the ends thereof to the trunk pipe line for pivotal movement and for limited axial movement, a seal on the other of said ends of the switch tube for being selectively engaged with the pneumatic tubes, resilient means acting on the switch tube for urging the switch tube towards the pneumatic tubes, actuating means acting on the switch tube to move the same angularly between first and second positions in which the switch tube is engaged with a respective pneumatic tube, said actuating means including a carrier pivotably connected to the switch tube and driven through a limited angle around an axis which lies between the trunk pipe line and the pneumatic tube and which extends perpendicular to the plane of movement of the switch tube, said carrier member being provided with a slot lying between the pivot axis of the carrier and the axis of pivotable movement

of the switch tube about the trunk pipe line, and a fixed pin on the switch tube slidably engaged in said slot, said slot being oriented in the carrier such that as the carrier undergoes pivotal movement to move the switch tube between said first and second positions, the carrier at the bottom of the slot initially acts on the pin to urge the switch tube axially towards the trunk pipe line and away from the engaged pneumatic tube against the action of the resilient means whereby the seal is displaced from the pneumatic tubes whereafter when the switch tube reaches the other of said positions the pin is free to be displaced in said slot and thereby the switch tube is urged axially by the resilient means into engagement with the associated pneumatic tube.

2. An improvement as claimed in claim 1 wherein said carrier is provided with a second slot extending at right angles to the first slot, the actuating means further comprising an angularly driven lever, and means on said lever slidably engaged in the second slot of the carrier for driving the same.

3. An improvement as claimed in claim 2 wherein said means engaged in the second slot is a roller, the actuating means further comprising a motor coupled to the lever to drive the same and thereby the carrier.

4. An improvement as claimed in claim 1 comprising means for the locking engagement of the pneumatic tubes and the switch tube when the latter is in said first and second positions, the latter said means including a second pin on one of the engaged tubes and a fixed slot on the other of the engaged tubes, said second pin being engaged

in the fixed slot to lock the tubes against angular displacement when the switch tube is in said positions.

5. An improvement as claimed in claim 1 wherein said actuating means further comprising a motor for driving the carrier member, switch means for controlling operation of the motor, said switch tube including an operating pin which contacts said switch means when the switch tube reaches said first and second positions and interrupts operation of the motor.

6. An improvement as claimed in claim 1 wherein said means connecting the switch tube and the trunk pipe line comprises two fixed elements on the trunk pipe line, said switch tube having recesses in which the fixed elements on the trunk pipe line are slidably received to provide the relative axial movement between the switch tube and the trunk pipe line.

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